circuit 12, 12^1, respectively, and employing a drive winding (not shown) to initiate the regenerative heating of one of said cross-bars to selectively drive its corresponding gate circuit 12, 12^1 to its resistive state so that the flip-flop 10 can be made to rapidly switch from one "state" to its other "state."

FIG. 9 is an example of the instant invention as it is applied to a superconductive switch wherein parallel paths are provided for the current entering lead 18 and leaving at lead 19. Superconductive elements 20 and 21 each lie in a superconductive path. It is desired to have all the current entering at lead 18 flow into one path only, say along the path that includes superconductor 21, then cross-bar 6 is driven to heat up regeneratively so as to apply its heat to the superconductive element below it, driving resistive the superconductive path that includes superconductive element 20 and diverting all the current through superconductor 21. When the path including element 20 cools to below its critical temperature, it will become superconductive again, but no current will flow in such path since there is no mechanism to cause the superconductive current in element 21 to be withdrawn therefrom. If it is desired to divert the current from the right branch of FIG. 9 to the left branch of FIG. 9 then the cross-bar 6^1 of its heat control trigger is actuated to drive the right branch resistive. Although only two parallel paths are shown, it is clearly understood that more than two parallel paths may be employed.

Turning to FIG. 1, it is seen how the heat control trigger serves also as an amplifier. Assume that the superconductor 1 to be controlled is a hard superconductor such as vanadium, whose Hc-T plot is shown in FIG. 4, and the soft superconductor cross-bar 6 is lead-indium. For a given temperature of 4° K., a small critical field applied to cross-bar 6 will cause it to go resistive but will have no effect upon vanadium since it needs a much higher critical field to make it go resistive. But the high heat developed by the cross-bar 6 when it regeneratively goes resistive will cause the hard superconductor 1 to go resistive. Since the current-carrying capacity of hard superconductor 1 is much higher than that of drive wire 7 and soft superconductor 6, a high current flow is controlled by a low current flow, resulting in amplification.

It is to be understood that it is not necessary that the hard superconductor be of a different material than the soft superconductor. If the superconductor to be controlled has a larger mass than the cross-bar or controlling superconductor, the former superconductor can be considered "hard" with respect to the latter superconductor. FIG. 5, for example, depicts the plot of critical current versus temperature of the same superconductor (lead) but the cross-section or the product of thickness and width of the superconductor is made variable, curve X having the least value for its thickness-width product, curve Z having the highest value, and curve Y having an intermediate value. For purposes of practising the instant invention, the lead that has the characteristic plot of the Z curve is a hard superconductor with respect to the lead corresponding to the plots of curve Y and curve X.

If desired, one may use the rapid heating that takes place when a hard superconductor is switched in accordance with the teachings of this invention to cause a soft superconductor to go resistive. This will not produce the amplification that takes place when a soft superconductor goes regeneratively resistive and its heat and collapsing magnetic fields are used to switch a hard superconductor, but the soft superconductor may be made to switch extremely rapidly. Such extremely rapid switching may have particular application in computing devices and the like.

FIGS. 10 and 11 relate to preferred embodiments of the invention when the latter is employed as an amplifier. Since the superconductive element 1 to be controlled may be carrying a current, such current will produce a field about the element 1. This field will be in the same direction as the field that is produced about cross-bar 6 when the latter has screening currents circulating therein. To prevent the field of the controlled element 1 from affecting the cross-bar 6, the former is disposed at right angles to the latter, as shown in FIG. 10, to nullify the undesired back effect of the field about element 1 upon cross-bar 6.

In FIG. 11, the element 1 to be controlled is bent back upon itself so that opposing fields are produced by the current being carried by superconductive element 1. Such opposing fields cancel and prevent a back effect upon cross-bar 6. It is to be understood that these same modifications depicted in FIGS. 10 and 11 can be applied to that embodiment of the invention shown in FIG. 3.

The principles of superconductivity and magnetic storage have been exploited in a novel way to produce a basic superconductive cell whose geometry is such as to permit rapid switching of a superconductive film or bar from its superconductive state to its resistive state in a time that is one hundred times faster than the switching time of ferrite cores. Considerably less current is required to switch such superconductive cell than is required to switch such ferrite cores. Moreover the inductive release of magnetic fields created by screening currents in the cell permits not only a rapid heating of the superconductive element of the cell so as to provide temperature changes of the order of

$$\frac{3\text{–}15^\circ \text{ K.}}{1\text{–}10 \text{ millimicroseconds}}$$

but it also provides for a very rapid break through of fields through a closed superconductive path, such rapid break through providing a relatively strong signal to a sensing circuit coupled to such cell. The novel cell described herein can be employed to provide extremely rapid control to other circuits, particularly circuits employing superconductive elements. The cell, dimensionwise, can be packaged in extremely small arrays, so that their use in computers and the like will reduce the overall size of the latter.

What is claimed is:

1. A superconductive device comprising a superconductive circuit that includes a closed superconductive path, a portion of said superconductive path being a soft superconductor as compared to other portions of said circuit, said soft superconductor portion being of the order of 0.3 cm. in length, 0.12 millimeter wide and 800 angstrom units thick, and said closed path is in the form of an arc having a radius of the order to 0.15 cm., means to cause said superconductive circuit to store energy and to cause said soft superconductive circuit to become normal conducting thereby dissipating said energy in the form of heat, heat insulating means having a predetermined heat conductivity surrounding said soft superconductor, said soft superconductive portion having a predetermined heat capacity and a predetermined critical temperature whereby the rate at which said energy is dissipated in the form of heat being fast compared to said predetermined heat conductivity, and the magnitude of heat produced by said energy being high as compared to said predetermined heat capacity so that said soft superconductor portion is driven above its critical temperature.

2. The device of claim 1 which further includes an additional superconductive member positioned in heat transfer relation to said soft superconductor portion.

3. A device according to claim 2 wherein said additional superconductive member is hard as compared to said circuit portion.

4. A superconductive device comprising a superconductive element in the shape of a rectangle that forms a closed superconductive path, a portion of one side of said rectangular element including a superconductive segment having a lower critical current than the rest of said rec-